## REMARKS

[001] The Office Action cites the following art: the present application as Applicant Admitted Prior Art (hereinafter AAPA); U.S. Patent Number 4,965,719 to *Shoens et al* (hereinafter *Shoens*); U.S. Patent Number 5,742,792 to *Yanai et al* (hereinafter *Yanai*); and U.S. Patent Number 6,973,549 to *Testardi et al* (hereinafter *Testardi*).

[002] Claims 1-30 are pending in the case. Claims 1, 12, 14, 21, 22, and 24 are independent claims. Claims 1-30 are rejected under 35 USC § 112. Claims 1-7, 9, 10, 14, 15, 17-25, and 27-30 are rejected under 35 USC § 103(a) as unpatentable over the combination of *AAPA* and *Shoens*. Claims 8, 16, and 26 are rejected under 35 USC § 103(a) as unpatentable over the combination of *AAPA*, *Shoens*, and *Yanai*. Claim 11 is rejected under 35 USC § 103(a) as unpatentable over the combination of *AAPA*, *Shoens*, and *Testardi*. Claims 12 and 13 are rejected under 35 USC § 103(a) as unpatentable over the combination of *Yanai* and *Shoens*.

[003] Applicants amended Claims 1, 4, 6, 9-12, 14, 19, 21, and 24. The amendments are supported by the original specification. No new matter has been added.

[004] The Applicants submit the attached amendments and remarks and respectfully request that the rejections be withdrawn and that the Claims be allowed.

## SUPPORT FOR AMENDMENTS

[005] Claims 1, 4, 9, 10, 11, 14, 19, 21, and 24 were modified to use synchronous operation consistently throughout the claims. As noted by the Examiner, some claims used lock, synchronized, synchronization, and/or synchronous operation inconsistently. Synchronous operation is defined in ¶¶18 and 57 of the published version of the specification.

[006] Claim 1 was further modified to emphasize the requirement that the synchronized operation must complete prior to the writing of data to the target volume. This is supported by

¶69 and Figure 4 element 440, showing that the associated operation or write completes after the lock has been acquired.

[007] Claim 4 was modified to emphasize that a lock operation comprises a lock command as supported by ¶18 of the published specification. Claim 4 was further modified in response to Examiner's comments to clarify the target of the lock command as Claims 4 and 6 were inconsistent.

[008] Claim 6 was modified to include the repetitive retries that the target storage controller may attempt as supported by the last sentence of ¶67 of the published version of the specification and Figure 4.

**OBJECTIONS TO THE SPECIFICATION**

[009] The Office Action (hereinafter OA) objects to the use of the term "computer readable storage medium" in Claims 24-30 for lack of antecedent basis in the specification. OA §4. Applicants submit an amendment to the specification that provides antecedent basis for the cited term. The amendment references definitions already offered in the original specification. As the term was used in the claims, the amendment to the specification does not constitute new matter.

[010] The Office Action correctly identifies Applicants' incorrect reference to a method 600 that should have been to a method 300. OA §5. Applicants submit an amendment to the specification correcting the reference. No new matter was added.

[011] The Office Action objects to Applicants' classification of prior art "transmission links" as "typically inefficient, having a much lower transmission rate than the read and write rates of the source storage controller." OA §5. The sentence objected to by the Examiner has been deleted.

**REJECTION OF CLAIMS 1-30 UNDER 35 USC § 112**

[012] Claims 1-30 are rejected under 35 USC § 112.

[013] The Office Action rejects Claims 1-30 under 35 USC §112. OA §7. Applicants address the §112 issues in the order presented in the Office Action with respect to each Office Action section.

[014] OA§8: Claim 1 has been amended to refer to the "synchronous operation" rather than the "lock operation" or "synchronized operation."

[015] OA§9: Applicants note that Claims 1, 12, 21, and 22 are to an apparatus, an apparatus, a system, and a system, respectively and that each of these embodiments comprises hardware or combinations of hardware and software such as a computer program product.

[016] OA§10: Claim 4 has been amended to state that the lock command is sent to the target storage controller as presumed in the Office Action §10.

[017] OA§§11-15: Claims 14, 19, 21, and 24 have been amended to use "synchronous operation." All other claims have similarly been amended to consistently use synchronous operation and to insure proper antecedent basis as noted in the Office Action.

**REJECTION OF CLAIMS 1-7, 9, 10, 14, 15, 17-25, AND 27-30 UNDER 35 USC § 103(a)**

[018] Claims 1-7, 9-10, 14-15, 17-25, and 27-30 are rejected under 35 USC § 103(a) as unpatentable over the combination of *AAPA* and *Shoens*.

[019] To establish a *prima facie* case of obviousness, the combination of prior art references must teach or suggest all the claim limitations. MPEP §2142. In addition, "it is insufficient that the prior art disclose[] the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the

combination made by the inventor." *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 934 (Fed. Cir. 1990).

[020] Applicants respectfully assert that the cited art does not teach or suggest all of the claim limitations of the present invention and that *Shoens* does not provide some teaching, suggestion, or incentive to combine the cited references. Specifically, Applicants **did not admit** the use of a **rollback log** is prior art and *Shoens* does not disclose sending data related to a **write** operation to a target volume without receiving a lock for the target region of the target volume (hereinafter referred to as a prospective write). Additionally, *Shoens* does not disclose a suggestion to combine. Finally, Applicants traverse the suggestion by Examiner that AAPA (applicant admitted prior art) discloses the claimed rollback log and the mirror control module as disclosed in the specification and Claims 1-7, 9, 10, 14, 15, 17-25, and 27-30.

[021] The present application uses the term "speculative operation," "speculative data mirroring" and the like to refer to the sending of data to a target volume prior to receiving a lock from the controller for the target volume. U.S. Publication 2006/0097289 to *Burton* (hereinafter *Burton*, throughout this Office Action Response, Applicants refer to the published version of their Application as *Burton*) ¶¶21, 22, 25. In this Office Action Response, Applicants refer to speculative write operations as "prospective writes." The *Shoens* application uses a form of "prospective reads" in which it allows programs to receive read data that is subject to a write lock that may later be invalidated if the underlying data is changed by the owner of the write lock. *Shoens* col. 2, 56-68; col. 3, ll. 5-34; col. 4, ll. 59-68. Applicants submit that the cited art only teaches the use of prospective reads and does not teach the use of prospective writes. In addition, the cited art does not teach the use of a rollback log with prospective writes. Finally, the teachings of *Shoens* teach away from a combination with any allegedly admitted prior art.

[022] Initially, it may be instructive to review the cited art and the present invention. *Shoens* discloses a control structure to "control concurrent access to data resources by multiple users." *Shoens* col. 2, ll. 55-53. *Shoens* teaches how to maintain coherency among copies of a block of data. *Shoens* Abstract; col. 4, ll. 56-67. *Shoens* allows multiple read accesses, but only a single write lock. *Shoens* col. 3, ll. 6-14. *Shoens* uses a lock manager that allows ***READ*** requests to overlap with a write lock request (referred to as an update lock in *Shoens* and referred to throughout this OAR as a write lock request). *Shoens* col. 3, ll. 6-14; col. 4, ll. 61-66. However, *Shoens* does not disclose a method that allows multiple concurrent writes or that allows prospective writes prior to the granting of a write lock. *Shoens* states that "the key aspect of implementing asynchronous lock requests is that the lock request processing must be done against the state of lock tables some time in the past." *Shoens* col. 5, ll. 33-35. *Shoens* relies on time-stamped lock requests and lock grants to determine when a lock should be validated or invalidated. *Shoens* col. 5, ll. 35-40.

[023] *Shoens'* stated objective is to "control concurrent access to data resources by multiple users" and "efficiently support record locking and buffer invalidation in N-way data sharing and to continue notification of resource change and adjustments to other processes holding locks in a transaction oriented environment." *Shoens* col. 2, ll. 55-68. While *Shoens* does seek to increase throughput, *Shoens'* method of increasing throughput relies on concurrent **prospective reads** in conjunction with a single update lock followed by notification to owners copies of read blocks that have been subsequently modified by a granted update lock. *Shoens* col. 2, 56-68; col. 3, ll. 8-18; col. 4, ll. 59-68. *Shoens* does not teach or suggest sending multiple writes or prospective writes to a storage system. *Shoens* does not use rollback logs for the reads

or for writes. Rather, *Shoens* notifies owners of copies of a locked data block that the prospectively read block is invalid. *Shoens* col. 2, ll. 64-68.

[024] Applicants disclose an apparatus, method, and system to increase throughput of writes to mirrored storage volumes that rely on writes to a **rollback log** in combination with **prospective writes** to a target volume prior to receiving a write lock for the target volume. *Burton* ¶13, Claim 1. To increase efficiency, Applicants teach writing to a rollback log associated with a source storage controller to allow backing the write out of the source if the requested lock fails. *Burton*, Claims 1, 7-9; *Burton* ¶¶ 57, 62. The entries of the rollback log define how to undo the write. Increased efficiency is achieved by prospectively writing data to the mirrored volume, since a mirrored volume will frequently grant the lock of a target storage region. The present invention does not rely on a synchronized logical clock or a means for encoding past states of held locks. *Shoens* states that it depends on "a synchronized logical clock [and] a means of encoding the past states of held locks..." *Shoens* col. 5, ll. 52-56.

[025] Applicants have amended Claim 1 to emphasize the write operation. According to Amended Claim 1, the synchronous operation (the request for the lock) must complete prior to writing any data to the target volume. This is supported by ¶69 and Figure 4 element 440, showing that the associated operation or write completes after the lock has been acquired. In contrast, *Shoens* allows the read operation to succeed before the granting of the lock. See *Shoens* col. 5, ll. 33-40. When a read is invalidated under *Shoens*, the resource lock manager sends notifications to prospective readers of a buffer that the previously read buffer is now invalid and must be discarded. *Shoens* col. 3, ll. 22-30.

[026] Thus, under the present invention, a prospective write is held in reserve until a lock is obtained. However, in *Shoens*, a prospective read is allowed to succeed and invalidated after the fact depending on the modifications by a write lock holder.

[027] *Shoens* does not teach prospective writes. *Shoens* system is not optimized for mirrored volumes. In fact, the design of the system in *Shoens* relies on no more than one update lock being granted at one time and on the ability to invalidate time stamps according to a synchronized clocking system that records the time that each lock is requested. *Shoens* col. 5, ll. 33-40. For these reasons, *Shoens* does not include the missing elements of the present invention as recited in the Claims.

[028] In addition, Applicants disagree that the background section of the application discloses a rollback log as recited in Claim 1. The Office Action states that the rollback log of Claim 1 is anticipated by ¶10, lines 2-5 of the submitted application (¶12 of the published application).

[029] The cited paragraph in pertinent part states:

> [0010] One technique used to improve data throughput is known as asynchronous replication. In this technique, a buffer is used to hold data that has not yet been sent across the transmission link 150 to a target storage controller 114b. Data corresponding to read and write operations on the source volumes 130a are stored in the buffer and are sent to the target storage controller 114b as soon as the transmission link 150 will allow. Thus, the source storage controller 114a can read and write to the source volumes 130a at close to full speed, independent of the transmission rate of the transmission link 150. While useful for some operations, asynchronous replication does not work for every operation. Some operations such as locking operations have required synchronization for proper completion.

[030] The Office Action suggests that the transmission buffer described in the cited paragraph is equivalent to a rollback log. Such is not the case. The transmission buffer

described with respect to asynchronous replication is used for storing "data that has not yet been sent." In contrast, a rollback log is used for backing out data already written to a hard drive. The purpose of the transmission buffer is to allow the source storage controller to write data to a temporary storage location. "Data corresponding to read and write operations on the source volume 130a are stored in the buffer and are sent to the target storage controller 114b as soon as the transmission link 150 will allow." The transmission buffer holds the data temporarily to allow transmission "as soon as possible."

[031] In contrast, a rollback log allows the subsequent removal of data from the source volume. The transmission buffer as described in ¶10 contains no teachings suggesting that the buffer may be used for backing out data already written to a source volume.

[032] As the description in the background section of a transmission buffer does not relate to the recited element of a rollback log, the Office Action inappropriately labeled the transmission log as a rollback log and cannot be used as AAPA against the present application.

[033] Finally, no motivation to combine the background section with *Shoens* exists. While *Shoens* seeks to increase throughput, the citation from *Shoens* Abstract does not give any suggestion to increase throughput through the use of prospective writes or through the use of a rollback log.

[034] In fact, *Shoens* teaches away from the use of prospective writes, stating that *Shoens* relates to prospective reads. *Shoens* col. 3, ll. 5-18; col. 4, ll. 59-58; col. 5, ll. 4-7. The stated desire to make an invention better does not provide the required suggestion, incentive, and motivation to **combine** two references. "When the combination of the two references create an unworkable invention, no motivation to combine exists. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where

there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art.

**Claim 1**

[035] Even if the background section is considered as a prior art reference, to which the Applicants object, the combination of the background and *Shoens* do not anticipate the prospective writes in combination with a rollback log as cited in Amended Claim 1. Amended Claim 1 emphasizes that the speculative mirroring operation involves a rollback log, a write operation to the rollback log, a synchronized operation on a target volume, the sending of write data to a target volume prior to the completion of the synchronized operation, and the writing of the write data to the target volume following the completion of the synchronized operation. *Burton* Claim 1. *Shoens* teaches away from prospective writes and the use of a rollback log. *Shoens* col. 3, ll. 5-18; col. 4, ll. 59-58; col. 5, ll. 4-7. Applicants respectfully submit that Claim 1 is allowable over *Shoens*.

**Claims 2-7, 9, 10, 14, 15, 17-25, and 27-30**

[036] Independent Claims 14, 21, 22, and 24 are directed to subject matter similar to that of Claim 1, claiming a rollback log and prospective writing to a target volume. For the reasons stated with respect to Claim 1, Applicants submit that independent Claims 14, 21, 22, and 24 are allowable for the same reasons discussed above with respect to Claim 1.

[037] Applicants also submit that dependent Claims 2-7, 9, 10, 15, 17-20, 23-25, and 27-30 are allowable as depending from otherwise allowable claims.

**REJECTION OF CLAIMS 8, 16, AND 26 UNDER 35 USC § 103(a)**

[038] Claims 8, 16, 26 are rejected under 35 USC § 103(a) as unpatentable over the combination of *AAPA*, *Shoens*, and *Yani*.

[039] To establish a *prima facie* case of obviousness, the combination of prior art references must teach or suggest all the claim limitations. MPEP §2142. In addition, "it is insufficient that the prior art disclose[] the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor." *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 934 (Fed. Cir. 1990).

[040] As discussed with respect to Claim 1, the cited AAPA and *Shoens* do not disclose or teach a rollback log. The AAPA and *Shoens* also do not teach or disclose the sending of prospective write data prior to the reception of a lock on a target volume. *Yanai* discloses a system for data mirroring between two storage systems. At column 9, ll. 60-col. 10, l. 2, *Yani* teaches a method that requires a source volume to block operation until an acknowledgement from a target volume. This teaching is inapposite with the concept of sending prospective write data prior to receiving a lock on a target volume. Consequently, *Yanai* teaches away from the present invention and is not a valid reference to support a *prima facie* case of obviousness.

[041] Applicants submit that the cited references of AAPA, *Shoens*, and *Yani* do not teach the use of a rollback log, nor do they teach the use of sending prospective write data to a target volume prior to the acquisition of a write lock. In addition, *Yanai* teaches away from the present invention. Consequently, Applicants submit that Claims 8, 16, and 26 are allowable claims.

**REJECTION OF CLAIM 11 UNDER 35 USC § 103(a)**

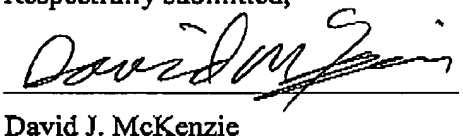
[042] Claim 11 is rejected under 35 USC § 103(a) as unpatentable over the combination of *AAPA*, *Shoens*, and *Testardi*. As discussed with respect to Claim 1, the cited AAPA and *Shoens* do not disclose or teach a rollback log. The AAPA and *Shoens* also do not teach or disclose the sending of prospective write data prior to the reception of a lock on a target volume. As cited by the Office Action, *Testardi* also fails to teach these essential elements. To establish a *prima facie* case of obviousness, the Office Action must cite references that teach all of the elements of the claimed invention. In the absence of such a *prima facie* case, Applicants submit that Claim 11 is allowable.

**REJECTION OF CLAIMS 12 AND 13 UNDER 35 USC § 103(a)**

[043] Claims 12 and 13 are rejected under 35 USC § 103(a) as unpatentable over the combination of *Yanai* and *Shoens*. As discussed with respect to Claim 1 and Claims 8, 16, and 26 *Shoens* and *Yanai* fail to disclose or teach a rollback log. *Yanai* and *Shoens* also do not teach or disclose the sending of prospective write data prior to the reception of a lock on a target volume. To establish a *prima facie* case of obviousness, the Office Action must cite references that teach all of the elements of the claimed invention. In the absence of such a *prima facie* case, Applicants submit that Claims 12 and 13 are allowable.

[044] For the reasons stated above, Applicants submit that the application is in condition for allowance. In the event any questions or issues remain that can be resolved with a phone call, Applicants respectfully request that the Examiner initiate a telephone conference with the undersigned.

Respectfully submitted,



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